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Report of the

FIFTEENTH SOUTHERN PASTURE AND FORAGE CROP IMPROVEMENT CONFERENCE

Clemson Agricultural College

Clemson, South Carolina

June 4 - 6, 1958

Report of the

FIFTEENTH SOUTHERN PASTURE AND FORAGE CROP IMPROVEMENT CONFERENCE[1/]

Clemson Agricultural College
Clemson, South Carolina

Wednesday, June 4, 1958

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Wednesday Morning, June 4, 1958

P. B. Gibson, Conference Chairman
C. H. Hanson, Program Chairman

9:00 A.M. Chairman Gibson called the Conference to order and introduced Prof. G. H. Collings, Head of the Agronomy Department of Clemson Agricultural College. Prof. Collings briefly reviewed the history of Clemson College and in turn introduced President R. F. Poole. President Poole officially welcomed the conferees to Clemson College and pointed out the growing importance of forages and forage research in South Carolina.

9:30 A.M. History of the Southern Pasture and Forage Crop Improvement Conference - Hayden Rogers, Univ. of Georgia, Athens, Ga.

The organization of the Southern Pasture and Forage Crop Improvement Conference was sponsored by the Pasture Committee of the American Society of Agronomy and the Southeastern Agronomy Research Committee of the Association of Southern Agricultural Workers.

During the 1939 meeting of the American Society of Agronomy the need for regional grassland conferences was discussed. In 1940 Secretary of Agriculture Wallace appointed O. S. Aamodt chairman of a committee to assist in organizing 5 regional grassland conferences throughout the United States. About the same time a group of research workers were discussing the same type of organization for the Southeast. C. B. Williams, Chairman of the Southeastern Agronomy Research Committee, appointed E. N. Fergus, J. W. Tidmore, R. L. Lovvorn, and G. W. Burton "to engineer the formation of a pasture conference in the Southeastern States if the agronomists interested in pasture research desired it." During the 1940 meeting of the Association of Agricultural Workers this committee, about 20 agronomists and one or two animal husbandry men, met and organized the Southern Pasture and Forage Crop Improvement Conference. The Executive Committee consisted of G. W. Burton, R. E. Blaser and E. N. Fergus, with R. L. Lovvorn as Chairman. O. S. Aamodt, Principal Agronomist in Charge, Division of Forage Crops and Diseases, was elected Permanent Secretary and a member of the Executive Committee. At a later date it was decided to add a representative of the Dairy Industry and one from Animal Husbandry to the Executive Committee.

The objectives of the Conference as adopted at the organizational meeting, were as follows:

1. To encourage the cooperation of all groups that are in a position to contribute to the pasture and forage crop improvement program.

2. To aid in the correlation of activities between workers.

3. To assist in the development of the program of the Association of Southern Agricultural Workers.

4. To act as a medium of exchange of ideas, methods of procedure, and needs of workers.

5. To act as an agency for the exchange of plant material.

6. To assist in the formation of a policy for the distribution of material.

The first meeting was held July 23-24, 1940, at the Coastal Plain Experiment Station, Tifton, Georgia. Inspection of field plots and round-table discussions comprised the program. Approximately 40 men representing 12 States and the District of Columbia attended the first meeting. Some of the problems discussed are still pertinent and remain unanswered. The following is copied from page 13 of the minutes of the 1940 meeting:

"The problem of 'What is palatability' needs clarification. How important a role does the lignification of the fibers play in the digestibility of herbage? What is the seasonal march of digestible nutrients in southern forage plants? Are peak yields of digestible nutrients per acre coincident with peak herbage production? Over how long can this peak of digestible nutrients be maintained? How are these to be correlated with biochemical studies which are frequently taken at a later stage of plant development than would be desirable for grazing purposes?"

Much has been accomplished during the past 18 years - much remains to be done if the South is to reach its potential in the production, management, and utilization of pasture and forage crops.

9:50 A.M. Report of S-12 Technical Committee Meeting - D. E. McCloud, Forage and Research Branch, Beltsville, Md.

The S-12 Southern Forage Crops Technical Committee deliberations centered around ways by which the research of this project could be more effectively directed toward regional objectives.

The committee decided that the work covered by S-12 was too broad and recommended that 3 regional projects should be formed, each with its own technical committee. The need for cooperation and coordination between these technical committees was recognized and it is recommended that the 3 committees continue to meet together at the Southern Pasture and Forage Crop Improvement Conference.

In separate work planning sessions objectives under each project were developed and committees formed to develop procedures and to submit the projects for consideration by the Southern Directors.

10:00 A.M. Introduction of Members and Presentation of State Reports

Alabama: Ten members present; State report by E. M. Evans.

Forages and livestock are receiving increasing emphasis in Alabama's research program as a means of utilizing our land resources and replacing a part of the income lost as cash crop acreages decline. Thus far the

proportionately more favorable position in the economy of the State occupied by livestock has been due more to the shrinking income from crops than to improvements in the livestock industry itself.

Last winter served to re-emphasize the need for a better feed program. Hay was in critically short supply in all areas of the State, with some cattlemen resorting to the feeding of molassified grain straw and worse to carry their herds through. An adequate roughage program is still one of Alabama's greatest needs as it develops into a livestock state. To help solve this and other basic problems, we have some 24 active projects and sub-projects in the State that are directly or indirectly concerned with pasture and forage crops production and utilization. These projects are in the areas of breeding, introduction, adaptation, fertilization, management, irrigation, cropping systems, feeding systems, mechanization and economic analysis. Supporting projects in the areas of plant and animal diseases and insect control are also active.

Results thus far point in several directions. Our most productive forages are not necessarily the most desirable ones for all purposes. The "best" slaughter animal may not be the most economical to produce. Such terms as "good practice", "economic unit", and 'balanced program" are still ill-defined in many areas and may defy precise definition for some time. The "best" grazing program may be "zero grazing" in some cases and may approach "year round" grazing in others but is apt to be somewhere in between for the majority of situations. There is still some art as well as science to finishing slaughter cattle and to maintaining summer milk flow. Irrigation, double-cropping and high nitrogen applications are causing a re-evaluation of mineral fertilizer requirements for harvested forages grown under those conditions of management.

The problem is further complicated by numerous pests, some new and others old. The clover seed weevil and lesser clover leaf weevil have greatly reduced seed production of white and crimson clovers in widespread areas in the State. Aphids seriously affected oats and caley peas in certain sections this spring. Army worm damage to small grains and clover was locally severe. Pepper spot and Sclerotinia took their toll of early clover growth in the northern section. Helminthosporium and yellow dwarf virus or some disease complex were severe on oats again this year. Stands of dallisgrass and bahiagrass as well as first-year Suwanee and N.K. 37 bermudagrasses were severely weakened by the long cold winter. This was especially so on dallis and bahia where abundant growth accumulated with the wet fall of 1957. The fire ant scare has subsided as knowledge of the pest is obtained. With a reported equilibrium of some 40 ant hills per acre it promises to become at worst a nuisance on permanent pastures and a mechanical hindrance on hay meadows and for combine-harvested seed crops.

Arkansas: Two members present; State report by M. S. Offutt.

The Arkansas Agricultural Experiment Station currently has 11 projects directly pertaining to improvement of pasture and forage crops in the Department of Agronomy. These projects are under the supervision of 5 project leaders, A summary of the main work being done on these projects is as follows:

1. Mr. Hileman is working primarily on the correlation of soil test results with the yield of forage crops on the major soil types in Arkansas. This information is being used to make fertilizer recommendations for the production of forage and pasture crops in Arkansas.

2. Dr. Foy is primarily concerned with the determination of the lime requirements of Arkansas soils for forage and pasture crop production. Dr. Foy is studying the effects of rate, source, and placement of lime on the yields and persistence of alfalfa, white clover, and bermudagrass.

3. Dr. Davis is in charge of the grass breeding project and is working mainly with orchardgrass, bermudagrass and dallisgrass. Dr. Davis also is working on the establishment, management, and evaluation of turf species.

4. Dr. Spooner is concentrating his program on the evaluation of pasture species and grazing management trials on the major soil types in Arkansas. He is also studying the effects of some of the physiological factors, such as moisture stress, water requirements, soil temperature, and air temperature, on the growth of forage and pasture species.

5. Dr. Offutt is supervising the alfalfa and lespedeza breeding and management projects. One of the main objectives in this program is the development of an adapted variety of pasture-type alfalfa. Dr. Offutt is also carrying on research with the vetches, lupines, and field peas to determine their relative value for green manure under different systems of management in Arkansas.

Florida: Nine members present; State report by G. B. Killinger.

Activities related to forage and pasture investigations in Florida are many and varied.

Some 8 branch stations and field laboratories in addition to the station at Gainesville have active projects dealing with forages and pastures. Almost all have a common goal on one project, that is, "High Level Production of Nutritious Herbage".

In North Florida, bermuda, bahia, orchard, fescue, canary, ryegrass, millet and cereal crops are being studied, along with crimson, white and red clovers, alfalfa and lupines.

In Central Florida, bermuda, bahia, pangola, millet and cereal crops, along with white, sweet and red clovers, alfalfa and lupines, are incorporated in experiments.

In South Florida, pangola, bahia, bermuda, carib, St. Augustinegrass, millet and oats and white clover and alfalfa are on trial.

Fertilization rates, ratios, applications and management of both perennial and annual grass and legume species continues.

Silage investigations with plastic-type bags and covers and hay making are also under way.

Gibberellic acid treatment of various forages at different periods of growth have shown some interesting leads.

Grass and legume breeding projects are in operation.

Plant introduction nurseries for new plants are maintained at a number of locations in the State, with much of the material in these nurseries coming from Dr. James, Head of the Plant Introduction Station, Experiment, Ga.

Minor element deficiencies or needs for various forages are being investigated.

Climatology or the micro-climate relationship of plants shows promise of some new concepts for forage and pasture research.

Grazing experiments at 5 locations involve fertilization, management and plant species.

Irrigation of pastures.

A cobalt 60 source for radiation studies(Gamma) with forages and planted seeds has been installed. Cobalt in a quantity equivalent to radiation of 10 pounds of radium is now on location. Field crop seeds, feeds, animals, etc. will receive treatment.

A new Plant Science unit is in the process of establishment at Gainesville.

Georgia: Nineteen members present; State report by G. W. Burton.

Dr. Burton briefly reviewed the forage program of the State. Breeding work with grasses and legumes is under way at Tifton and Experiment, Ga. Fertility, management, and grazing studies are under way at the main station and also at a number of the branch stations.

Kentucky: Three members present; State report by N. L. Taylor.

Dr. Taylor reported that the State investigations covered the 3 forage phases: breeding, management, and utilization. Breeding for increased palatability of tall fescue and greater disease resistance and productivity of red clover, white clover and pasture-type alfalfa is being done. A new, longer-lived, more productive variety of timothy, named Clair, is being released. Studies of methods of maintaining legumes in grass sods, fertility tests, etc., are being carried out. Utilization studies are concerned with techniques for measuring nutritive value of forages for ruminants.

Louisiana: Three members present; State report by C. R. Owen.

Pasture and forage crop research include breeding, variety and new strain evaluation using small plots, and pasture evaluation with livestock.

Breeding investigations are under way with dallisgrass, white and red clover and annual lespedeza. Objectives for the improvement of dallisgrass are: development of strains superior for seed production, forage production and resistant to disease. Heat tolerance and persistence are desired in white clover, with powdery mildew and root rot resistance in red clover. Strains of lespedeza with resistance to Sclerotium rolfsii and other fungus diseases are needed for condidtions in south Louisiana. New strains have been developed and released of dallisgrass, white clover, and red clover. Irradiation studies are under way with dallisgrass through the cooperation of the University of Tennessee-Atomic Energy Commission and the Agricultural Research Program.

New varieties and strain evaluation have been under way during the past 10 years with the major forage and pasture crops in the South. These are planted in small plots adequately replicated and suitably arranged for statistical treatment of the results. The yields are taken by mowing to simulate grazing or to determine total growth, depending upon the crop; that is, whether it is adaptable to be utilized by grazing animals, for hay, or for silage.

Pasture experiments with grazing animals are conducted within the Departments of Animal and Dairy Industry. Response of certain crops to irrigation is being studied by the Dairy Industry and experiments to determine the maximum grazing time on permanent-type pastures is a project under way with beef steers.

Branch experiment stations located in the major soil areas of the State are each engaged in research with pasture and forage crops. At Franklinton, for example, which is located in the New Orleans milk shed area, the work emphasizes research with pastures for dairy cows. In other areas the programs are planned for the solution of their specific type of problems. Certain of the branch stations also cooperate with strain evaluation with small plots.

Mississippi: Three members present; State report by C. M. Johnson

North Carolina: Twelve members present; State report by C. H. Hanson.

Oklahoma: Three members present; State report by J. R. Harlan.

Research now in progress includes the following:

1. Cytological studies - emphasis is primarily on the tribe Andropogoneae, with special emphasis on the Sorghum and Bothriochloa groups. Most of the work is in the genera Sorghum, Bothriochloa, Dicanthium and Capillipedium.

2. Plant breeding - emphasis is primarily on the Bothriochloa group at Stillwater and native grasses at Woodward. Some selection work is also being done with sorghum, alfalfa, vetch, bermudagrass, orchardgrass. bromegrass, Phalaris spp., Eragrostis spp., and other miscellaneous grasses and legumes. Most of the work at the moment is in trying to understand the Bothriochloas and to make appropriate hybrids for the production of adapted types.

3. Seed technology - emphasis is primarily on developing suitable tests for viability and purity determinations. The official procedures are often misleading and better methods are urgently needed. Other studies include longevity under various conditions of storage and the nature of dormancy.

4. Seed production - emphasis in the past has been on the fertility requirements of native species under irrigation for seed production. New studies on weed and insect control and harvesting methods are being initiated this year.

5. Testing and Evaluation - emphasis has been on plot tests of numerous varieties and species for yield, adaptation, behavior under clipping, and chemical composition. The most intensive studies have been on varieties and species of small grains, but some 175 varieties of some 36 species are being tested in the program.

6. Pasture management - emphasis has been on the management of bermuda-based pastures, although some 13 species of forage plants are being studied with grazing animals. Small grains. sudangrass, bermuda-base mixture and brome-alfalfa have been studied under irrigation, and blue panic and switchgrass have been established for management studies under irrigation. Nitrogen fertilizer is being compared with vetch on bermudagrass. Other fertility studies are under way.

7. Weed and Brush control - emphasis is on testing of new herbicides and the determination of the best rates and dates for effective control of weeds in crops, pastures and ranges and the control of woody plants in rangeland.

8. Turfgrass - emphasis is on evaluation of selected materials for turfs and the management requirements for each.

Puerto Rico: J. Velez-Fortuno, the only member from Puerto Rico, reported that their forage program is concerned very largely in the evaluation of grass and legumes in various mixtures. Kinds under study include species of Panicum, Pennisetum, Digitaria, Pueraria, Melinis, and others. Studies include various mixtures in fertility trials with and without irrigation.

South Carolina: Twenty-four members present; State report by R. F. Suman.

R. F. Suman from the Edisto Station, reported on a grazing study recently initiated at Blacksville, in which the productivity of Coastal bermuda is being evaluated under different rates of fertilization.

Tennessee: Two members present; State report by H. A. Fribourg.

Forage crops research is being carried on in Tennessee at a number of locations, distributed so as to cover all the major physiographic, edaphic and climatic areas of the State. Agronomic plot investigations are under way at 5 different locations. Beef grazing experiments are being carried out at 7 locations and dairy field experiments at 5 locations.

In the Department of Agronomy the effects of rate and placement of seed and fertilizer on the establishment of alfalfa-orchardgrass, ladino clover-orchardgrass and ladino clover-fescue are under study. Several experiments were initiated recently to study the changes in botanical composition and stands in ladino clover fields containing various amounts of orchardgrass and fescue, either singly or together, when subjected to varying levels of nitrogen fertilization and intensities of defoliation. Work is continuing in the study of the effects of nitrogen fertilization, spacing, and clipping and defoliation intensities on the production, recovery and nitrogen content of several summer annual grasses. The establishment of legumes, primarily ladino clover, in old fescue sods, is being studied; both mechanical means of land preparation and chemical means of weakening the sod are being investigated. A comparison of different forage crop species and mixtures was initiated recently on newly-cleared land on the Cumberland Plateau, the objective being to determine which mixtures can bring newly-cleared land into production the most rapidly.

Irrigation experiments with Starr pearl millet are continuing at two locations. Combinations of irrigation and nitrogen fertilization have increased forage production from a little over 1.5 tons with no nitrogen and no irrigation to 5.5 tons with heavy irrigation and 240 pounds of nitrogen per acre.

A sudangrass synthetic variety has been developed and appears to compare favorably with other varieties in the experimental strains tests throughout the State. Selection of Kentucky bluegrass strains for better sod formation and rust resistance continues. Strains of orchardgrass selected from long-time farmer stands have, over a period of several years, survived much better than the stand obtained from Danish seed.

In the forage legume breeding project, three generations of irradiated Korean lespedeza and crimson clover were grown without any worthwhile variants being found. Second-generation sericea is now in its third season of growth. When a good test for total "tannins" has been devised, it is proposed that single plants will be tested for tannin content. Microscopic sections of maturing crimson clover heads show definite formation of abscission layers. Growth and development measurements of crimson clover have been made for a full cycle, with and without radiation.

The Dairy Department first compared in 1957 the feeding value of Gahi-1 pearl millet, Starr pearl millet and Piper sudangrass at two locations. This work is being continued in 1958. No differences were obtained between their forages and their ability to support milk production and maintain bodyweights. Likewise, butterfat tests were not significantly different.

The project "Evaluation of Orchardgrass, Tall Fescue and Ladino Clover in Combination and at Various Rates of Nitrogen Fertilization as Reflected in Beef Gains and Forage Yields," which accompanies a beef grazing project in Animal Husbandry, has obtained no close correlation between tonnage and forage produced and beef gains.

The Department of Animal Husbandry has recently completed a study on "The Effects of Fescue Forage and Seed on Laboratory Animals." No positive results were obtained from many of the tests run using fescue forage from toxic pastures. It appears that tall fescue seed contains a growth inhibitor for rats which may be partially destroyed by autoclaving or by treatment with dilute N^aOH and HCL.

Performance of weanling calves on various roughages including corn silage, corn sorghum silage, sorghum silage, grass silages, small grain silages, and various hays is being compared. Rate of gain, animal grades, and amount of feed per unit of gain are used as response criteria. "Crude estimates" of yields are also recorded. Two lots of calves are fed each of several roughages in any one experiment in most instances and each experiment is to be repeated at least 3 times. Various pastures including Kentucky bluegrass, fescue, orchardgrass, ladino clover, and alfalfa are being evaluated by animal grazing trials. Fertilization and irrigation effects are also being studied. Two or 3 replications of each pasture treatment with two to 3 test animals per replication are being used. Experiments are to be repeated 3 to 4 times. Washed suspensions of rumen bacteria are being used to evaluate forages in vitro. Existing artificial rumen techniques have been modified and a workable technique has now been perfected. Activity of bacteria (when only source of nutrients is forage) is used as a criterion of forage nutritional value.

Texas: Four members present; State report by E. C. Bashaw.

The over-all objective of the dallisgrass program at College Station is the development of a highly fertile dallisgrass strain. The program involves studies of the influence of environment on seed set, cytogenetic

studies of the mode of reproduction, the use of irradiation for mutations and a study of the cytological effects of irradiation, and hybridization studies.

The potential seed set of common Dallisgrass is quite low, seldom over 40%. Our studies show that seed set varies with climatic conditions within the range of 0 to 40%. Practically no seed is formed under conditions of high temperature and low humidity which generally prevail in Texas in July and August. These studies indicate that environment is not responsible for the low potential seed set.

Cytological studies show that common Dallisgrass is normally apomictic and that the mechanism of apomixis is apospory and pseudogamy. Cells of the nucellus form multiple embryo sacs which frequently give rise to proembryos prior to anthesis; however, pollination is necessary for endosperm development. Embryological studies suggest that competition among multiple embryo sacs may be responsible for low fertility.

Irradiation was effective in producing a wide range of mutants for morphological characteristics such as leaf width, growth habit and anther color. Studies of seed set through the X_2 generation have not revealed any plants with higher seed set than the potential of untreated plants. However, at some harvest dates certain irradiated plants had significantly higher seed set than all control plants. Further study is being made of the better plants with greater statistical control.

Our attempts to hybridize Dallisgrass have been generally unsuccessful; however, one hybrid has been obtained between common and a highly fertile, yellow-anthered plant introduction. Cytological studies show that the hybrid developed from the fertilization of an unreduced egg of common. The hybrid is apomictic and only sets 15 to 20% seed.

U.S.D.A.: Eight members from Beltsville, Md. and Washington, D. C. were introduced.

Virginia: Seven members present; State report by R. E. Blaser.

11:30 A.M. Business Meeting - P. B. Gibson, S. Car., Chairman

Dr. Gibson reported on the appointment of a committee concerned with uniform standards for the evaluation of forages. The committee is as follows:

E. N. Fergus, Ky. Chairman
H. L. Lucas, N. Car.
R. E. Blaser, Va.
M. E. McCullough, Ga.
W. B. Anthony, Ala.

Dr. Fergus could not attend the conference but had requested that the committee be given another year in the preparation of their report.

Dr. Gibson reported the necessity of electing a new member to the Executive Committee and also a new Permanent Secretary. A nomination committee to suggest candidates for these two positions, composed of W. W. Woodhouse, Chairman; W. B. Anthony and J. R. Harlan, was appointed by Dr. Gibson.

Chairman Gibson noted that we frequently develop resolutions at our conferences. To aid in this development the Chairman appointed Earl S. Horner (Fla.) and Glenn W. Burton (Ga.) to a resolution committee.

Announcements with respect to the field tour and registration were made by Dr. Earhart. There being no more business at this time, the meeting adjourned.

Wednesday Afternoon, June 4, 1958

1:30 - 5:00 P.M. Field Tour

The forage and pasture experimental work under way at Clemson College was observed in a well-planned tour. Two separate tours were made, one by buses and another by trucks supplied by the host institution.

The tour by bus included stops to observe experimental pastures, (1) to measure the value of ryegrass and crimson clover top-seeded on common bermuda. (2) to measure the value of Coastal bermuda pastures for fattening beef steers with and without grain supplement, and (3) common bermuda utilization in beef production, and plot tests of production of Coastal bermuda as affected by potash and nitrogen fertility levels, and evaluation of bermudagrass lines for resistance to Helminthosporium foliar diseases.

On the tour by trucks the grazing studies under way by the Dairy Department including Coastal bermuda management for hay and silage, milk cow performance on rescuegrass, fescue management, and nitrogen fertilization as affecting palatability and milk cow performance, were observed. Also observed were the micro-climatic studies on white clover-fescue associations; white clover breeding, disease, and evaluation studies; orchardgrass variety trials and many others.

Wednesday Evening, June 4, 1958

7:30 P.M. Informal Discussions - C. H. Hanson, N. Car., Chairman.

1. Field trip - An informal discussion was held covering the field tour with Dr. Earhart directing the questions to appropriate members of the Clemson staff. Questions dealt in general with the management and techniques used in conducting various experiments.

Ruelke: How much N can be profitably applied to tall fescue?

Peele: I do not know how high we can go. 200 pounds of N cleared $80 per acre with beef cattle. Dr. Conley reported that with 250 pounds of N they were still making money.

Blake: What was the percent protein in Coastal bermuda at the 200-pound rate of N for the different cuts?

Boykin: At the 12" stage the percent protein for the 1, 2, 3, and 4 cuts was 12.5%, 17.9%, 14.8% and 16.3%, resp.

Sell: What was the rate of grain feeding for dairy cattle?

Conley: One pound of grain for each 3 pounds of .4% milk. It was estimated that most of the milk came from the grain.

Hanson: What was the purpose of the light in the cages containing the white clover plants?

Gibson: Lights are on from sundown to midnight for a 2-month period before flowering. Results in the development of a maximum number of flowers and reduces normal differences in flowering.

Hanson: Is this amount of lighting necessary?

Gibson: 30 minutes of light at midnight was effective.

Offutt: How many bees per cage?

Gibson: One small colony.

Ward: How do you regulate the number of cows in the pasture studies?

Conley: Put and take, depending upon the amount of ungrazed forage.

Offutt: Have you made any interspecific crosses in the Trifolium spp.?

Gibson: Crossing has been a minor part of the program. We have attempted to cross polyploid white and also tetraploid alsike and do not yet know how successful we have been.

Hollowell: Some crosses have been made but studies have not gone very far. Considerable work is under way.

8:15 P.M. Calendar Date vs. Stage of Growth as a Criterion for Harvesting Forages - R. E. Blaser, Va., and G. W. Burton, Ga.

Cutting and Grazing Management of Forages Should be Based on Stage of Growth Rather Than on Calendar Dates - R. E. Blaser 1/

The primary advantage of cutting herbage on a calendar date is that of setting up a schedule of work for the entire season without giving attention to the physiological condition as displayed by the morphological characteristics of the herbage. The calendar date of cutting is also convenient for clipping techniques because feed needs and quality of herbage for animals need not be considered. If growth rate during the growing season would proceed at a constant rate, then cutting treatments based on calendar dates would be tenable. There is a decided difference in rate of plant growth at various seasons of the year because of temperature, moisture, light, and other factors that influence growth.

1/ Presented by C. Y. Ward, Va.

It is well-known that organic food reserves in the stubble, rhizomes and roots supply foods for new growth after each defoliation. In certain species, such as bromegrass, growth stage of the herbage is associated with the growth status of the new shoots which have a remarkable effect on the rate of growth after cutting. As growth proceeds in most species, carbon synthesis exceeds respiration and foods in the depleted organs of plants are restored. The replenishing of the food reserves are more positively correlated with physiological stage of growth than with calendar age of plants. Looking at a calendar instead of growth condition of plants precludes that physiology of plant growth is unimportant or uncomprehended.

Herbage quality is more highly associated with stage of growth(morphological growth condition) than with calendar age of plants. Feeding a given herbage 4 weeks old in Florida would probably be quite different from 4-week-old herbage in New York. Conversely, using sudangrass in feeding experiments at both locations when cut at an 18-inch height would have a definite meaning to plant and animal scientists as well as to farmers and professional workers. In rotational grazing experiments moving animals from lot to lot on a calendar basis would not be workable from year to year nor within a season.

We know that orchardgrass-ladino clover mixtures cut when 5 inches high produce about 40% less herbage than the same mixture cut when 8 inches high. Four cuttings of alfalfa made at an early bloom stage will produce about twice the yield of alfalfa cut in a prebud stage. When considering nutritional quality of the herbage, longevity of a species in a mixture, and yield of species, we find it very practical to discuss grazing management with farmers on the basis of: (1) height or stage of growth when cut or grazed and (2) closeness of cutting or grazing.

Cutting or grazing experiments based on stage of growth will yield more standardized data that can be readily comprehended anywhere. If cuttings must be made on calendar dates, then the morphological condition of the herbage should also be given.

Criteria for Determining Growth Stage in Forage - G. W. Burton.

The stage at which forage is harvested is very important because it affects:

1. The longevity of the plant
2. The productivity of the plant
3. The quality of the plant
4. The animal response to the forage
5. The repeatability of the results

A brief discussion of 6 harvesting criteria follows:

1. Flower development is quite effective for determinate forages during the season that they flower. Later in the season, this criterion will not work for determinate plants like orchardgrass and the non-flowering or indeterminate species.

2. The appearance of new shoots has been used as a criterion for the hay stage in alfalfa.

3. Leaf percentage would probably be a reasonably satisfactory criterion, but would not be easy to determine. Old leaves would not be as high in quality as young leaves.

4. Height is fairly easy to define and measure but varies greatly with fertility and moisture gradients.

5. Chemical analyses are too laborious and too slow for most purposes.

6. Age or harvesting by the calendar is the easiest method to define and determine and will permit scheduling, which helps the farmer and research worker to plan their harvesting operations. Coastal bermudagrass forage varied less in protein content when cut at a uniform age than when cut at a uniform height. In the summer of 1957, young and old leaves were harvested from the same stems of pearl millet and sudangrass by taking the top leaf and about the fourth leaf on stems just heading. These leaves were accumulated in quantity on 3 different occasions and were fed free of choice to Jersey cows. The average percentage consumption of young and old leaves of millet was 79.1 and 25.8%, respectively. Young leaves of both grasses were consistently higher in protein and lower in lignin. Unpublished data from Cornell University show a decline in protein content in timothy and white clover leaves with an increase in age. With constant growing conditions, height and age would be expected to correlate perfectly. When elongation is delayed by drought or inadequate nutrition, these criteria will not correlate well from season to season. Then age would appear to give the best measure of quality, since the aging of cells marked by a reduction in protein and an increase in lignin seems to continue even though elongation may be slowed down.

Thursday, June 5, 1958

8:15 A.M. Morning Session - Groups 2 and 3.
O. C. Ruelke, Fla., Chairman
G. M. Prine, Fla., Section Secretary

8:22 A.M. Establishment and Subsequent Growth of Four Legume Species as Influenced by the Application of Nitrogen Fertilizer at Seeding Time - C. Y. Ward and R. E. Blaser, Va.

The use of small amounts of nitrogen fertilizer for establishment of legume-grass mixtures is a commonly recommended practice in many areas. Very little research data are available which justify such a recommendation. Work has been under way in Virginia for several years to study the effect of nitrogen applied at seeding time on seedling growth and subsequent stands of the more common forage legumes. The nitrogen is applied as NH_4NO_3 at four rates (0, 20, 40, and 80 lbs. per acre) and worked into the soil prior to seeding.

Results show consistent nitrogen toxicity as evidenced by seedling death losses due to plasmolysis of young tissue. This results in poorer stands and erratic growth rate of the surviving plants. The Trifolium spp. are much more sensitive to nitrogen burning than either Lotus or Medicago spp. This study is being repeated annually.

Discussion:

Question: Were the seed band-seeded?

Answer: No, broadcast.

Q.: Were commercial N sources other than NH_4 NO_3 used?

A.: No.

8:37 A.M. Effect of Seed and Fertilizer Rate and Placement on the Establishment of Small-seeded Grasses and Legumes -
H. A. Fribourg, Tenn.

Due to the difficulty involved in the establishment of some small-seeded grasses and legumes, a series of experiments was initiated in the spring and fall of 1957 in Blount County and in the fall of 1957 in Maury and Robertson Counties with the following objectives in mind: to study the effects on stand establishment of banded and broadcast fertilizer applied with various rates of banded and broadcast seed; to study competition effects between grasses and legumes when seeded alone and in combination at different rates when both seed and fertilizer are banded; to determine the separate effects on establishment of the placement of bands of nitrogen and potassium fertilizer and phosphorus fertilizer in relation to the placement of seed; and to determine the effect on seedling establishment of distance of fertilizer band from seed at different fertilization rates. Some of these treatments, as well as a few additional ones, were established in Blount County in the spring of 1958; no results are available as yet on these seedings.

Stand counts were employed as a means of determining which treatments offer promise in successful forage establishment. It has been pointed out that information of value may be obtained in this manner without taking the experiment to later stages of plant development, although this will be desirable in subsequent years.

The following conclusions may be drawn from the data presented herein:

1. Better stands generally may be obtained in the spring through establishment by the band method, especially when conditions are not optimum.

2. When the band method of seeding is employed, nitrogen, potassium and phosphorus fertilizers in combination should not be banded at high rates directly beneath the seed, but below and to the side, to prevent possible seed and seedling injury.

3. Stand counts obtained from the fall seedings indicate that when conditions are near optimum, the broadcast placement of seed and fertilizer will produce as high or higher initial stand counts as when both are banded.

4. When seed is broadcast over a band of fertilizer, taller, more vigorous plants are produced directly over the band.

5. Better winter survival may be obtained from fall seedings when both seed and fertilizer are banded.

6. Adherence to recommended dates of seeding is urged. However, if departure from the recommended dates of seeding is necessary, the band method of seeding forage species may make possible the successful establishment of small-seeded species when the use of customary practices might lead to failures.

8:53 A.M. Renovation of Carpetgrass - R. M. Patterson, Ala.

Renovation of carpetgrass pastures by use of chemicals and tillage and their combination was studied in a series of experiments begun at the Tuskegee Experiment Field in 1956 and at the R. L. Moore farm near Auburn in 1957. Dowpon was applied at rates of 5, 10, and 15 pounds per acre in late July and early August. Some plots were turned about 10 days after spraying and were fallowed until planting. Other plots were not chemically sprayed but were turned and fallowed. Lime and fertilizer were applied according to soil test. White clover with either dallisgrass or Pensacola bahiagrass was seeded in mid-September with a grain drill equipped with a small seed attachment.

Excellent stands of white clover were obtained where planted on a chemically killed sod that was not plowed and disked. The stands and early growth were slightly better where highest rate of chemical was used. However, there were no significant differences in white clover yields resulting from the 3 rates of Dowpon. Spraying the sod before fallowing had no effect on the stand or yield of white clover or on the survival of carpetgrass. Therefore, the results from the conventionally fallowed plots and those sprayed prior to fallowing were combined for this discussion. Damping-off and heaving occurred on some of the prepared plots, but they were no problem on the chemically killed sod.

The dry forage yields in pounds per acre during the 1957 grazing season from the Tuskegee Experiment Field carpetgrass pasture renovation test are given below. The white clover and carpetgrass yields are averages of all plots for each method. Bahia and dallisgrass yields are averages of plots seeded to them.

Method	White Clover Lbs.	Bahiagrass Lbs.	Dallisgrass Lbs.	Carpetgrass Lbs.
Chemical	3,780	432	1,623	1,370
Fallow	3,273	868	1,000	1,322
Seeded only	722	0	1,522	4,739
None	63	--	310	4,598

The carpetgrass and dallisgrass stands resulting from the several renovation treatments are listed below. These stands are given as the percentage of vegetation at the end of the first growing season at the Tuskegee Field test started in 1956.

Method	Carpetgrass	Dallisgrass
	Pct.	Pct.
Chemical	26	57
Fallow	21	41
Seeded only	68	26
None	80	17

The percentages of carpetgrass and bahiagrass at the end of the first growing season are as follows:

Method	Carpetgrass	Bahiagrass
	Pct.	Pct.
Chemical	22	35
Fallow	16	49
Seeded only	79	0
None	80	--

No bahiagrass was established when carpetgrass was not controlled.

This report should not be considered a recommendation for use of Dowpon on pastures since this chemical has not been cleared for this purpose under the provisions of the Federal Food, Drug, and Cosmetic Act.

Further study is being conducted to determine the length of beneficial effects from chemical pasture renovation.

Discussion:

Question: How soon after applying the chemical(Dalapon) can seeding be made?

Answer: This was not investigated.

Q.: Did you apply chemical renovation to areas having a high infestation of smut grass?

A.: Yes, Dalapon caused burning of top growth of smut grass following application but the smut grass recovered.

9:17 A.M. Grazing Experiments with Several Rates of Nitrogen on Three Grasses - W. R. Langford, Ala.

No abstract.

Discussion:

Question: How did you control quality of grass in July and August?

Answer: By controlling the stocking rate of pastures.

Q.: Did cattle go down in grade from June to September?

A.: The animals continued to gain but possibly went down in grade, though grades were not determined in the study.

9:37 A.M. The Effect of Cutting, Management, and Temperature on the Growth of Annual Sweet Clover - R. D. Staten, Texas.

Fundamental information on growth behavior patterns of specific varieties of legumes in response to climatic factors and management practices should provide a better basis for improving management practices, determining areas of adaptation and determining breeding objectives and procedures, particularly for new crops or new and different varieties.

The response of 3 varieties of sweetclover to temperature and cutting management was studied. Little difference was noted in the growth of Hubam, Floranna and Israel sweetclover during the winter months as long as temperatures remained above 25°F. Temperatures below 25°F. retarded the growth of Israel, Floranna and Hubam for about 21, 14 and 7 days, respectively, even after growing temperatures had occurred.

The bi-weekly growth increments of all varieties were positively correlated with mean temperatures, but the relationship was closer during the spring than during the winter. With a wide range in stage of development and maturity, as represented by these sweetclovers, harvesting all varieties when the early maturing types reach the bloom stage placed the late variety at a yield disadvantage.

Discussion:

Question: Is Israel sweetclover grown as a hay crop or as a green manure crop?

Answer: Both, depending upon the management of the farmer.

10:10 A.M. Microclimate Measurements of Temperature in the Field as Related to White Clover - E. G. Beinhart, S. Car.

Microclimate investigations at Clemson are one phase of a study of the physiology of white clover supported co-operatively by the Agricultural Research Service and the South Carolina Experiment Station.

Primary objectives of the work described here are to measure the temperatures of the soil surface and the zone immediately above and below, to study the factors which affect these temperatures, and to determine the relationships between environmental temperatures and those inside the various plant organs.

Electrical resistance thermometers are being used with an automatic recorder to provide continuous records of soil temperatures at depths of 1, 6, and 12 inches below the soil surface, and 3 inches and 4 feet above. These data will be used to define the diurnal and seasonal variations in environmental temperatures, and will be correlated with growth and persistence results from the plots in which they are being measured.

Thermocouples are being used to measure temperatures at the soil surface, and 0.5, 1, 2, 4, 8, and 16 centimeters above the surface. Thermocouples are also being inserted into leaves, petioles, and stolons of clover plants to measure internal temperatures under selected conditions.

Three basic conditions of surface cover have been studied: (1) the soil surface completely bare of cover; (2) the surface shaded by a grass-clover association, with luxuriant foliage to a height of 3 inches; and (3) a grass-clover association cut to a height of 1 inch or less, leaving the surface mostly exposed.

Results to date show the modifying influences on microclimate temperatures on foliar shading and surface moisture. Differences between internal temperatures of stolons, leaves and petioles are apparently quite large. The relationship between soil surface temperature and the temperature within stolons is not yet clear. The surface temperatures of different soil types may differ considerably under identical conditions of insolation. Generalized conclusions await further work along the lines outlined.

Discussion:

Question: Would temperature be the reason for low seed set in second cuttings of white clover harvested for seed?

Answer: This has not been studied.

Q.: How was the thermocouple placed in the leaf?

A.: Forty-gauge thermocouple wire was inserted in the midrib of the leaf.

10:37 A.M. Influence of Nitrogen Fertilization, Management, and Gibberellic Acid on the Yield and Winter Survival of Southern Grasses - O. C. Ruelke, Fla.

The influence of nitrogen fertilization, management, and Gibberellic acid on the forage yields and winter survival of bermudagrass (Cynodon dactylon), bahiagrass (Paspalum notatum) and pangolagrass (Digitaria decumbens) was studied.

Time of application and amount of nitrogen fertilizer as well as the amount of plant cover going into the winter, materially affected winter injury and yield of certain perennial grasses. The summary of 1957 forage yields showed that there was a distinct increase in total seasonal yield

with increasing amounts of nitrogen. The total seasonal yields did not differ greatly where the forages were cut to simulate continuous grazing as compared to where a winter reserve was accumulated. Yield of Pangloa-grass forage were only slightly greater where the nitrogen was applied late as compared to early application. The estimated percentage of winterkill was greater in Pangolagrass which was fertilized late than in comparable early-fertilized grass. The reserving of forage to provide winter feed did not cause as much winter injury in the plots as it did last year.

The average increase in weight of dry matter harvested from the first cutting following a spring application of 50 gms. per acre of Gibberellic acid to Coastal and Suwanee bermudagrass, Pensacola and Argentine bahiagrass, and Pangolagrass under simulated continuous graz-ing management and various fertility levels was 480 pounds or a 24.6% increase. The average increase in weight of dry matter harvested from the fifth cutting which followed a fall application of Gibberellic acid was 367 pounds, and where spring and fall applications were applied it was 384 pounds. The application of Gibberellic acid did not statistically increase the overall total season yield of forage but did increase the amount of forage available in early spring and late fall when forage is in short supply.

Discussion:

Question: Did Gibberellic acid affect winterkilling?
Answer: No effect on winterkilling was noticed.
Q.: Was Gibberellic acid applied during the summer?
A.: No.

10:55 A.M. Production of Rye under Cold Weather Conditions -
E. S. Luttrell and U. R. Gore, Georgia

In many of our tests in the Piedmont and Coastal Plains, rye has con-sistently produced more winter forage than oats or wheat. Rye has less disease troubles than oats and grows at lower temperatures, but is not as palatable as oats. Rye heads up earlier and cannot be grazed as late in the spring as oats.

From 1950-1958 at Experiment, Ga., many varieties of small grains have been tested for winter forage production. These included commercial varieties and a few experimental lines. Cultural practices such as fal-lowing the land, early planting, rotation, and split nitrogen applica-tions were used in these tests. For the 9-year average comparison of forage produced to March 1, oats produced 2331 pounds and rye 3297 per acre. Rye produced 966 pounds or 41% more than oats. In 1951 a November freeze (7° F) damaged oat stands, yet rye produced 2632 pounds of forage and oats 430. In only two winters did oats excel rye in for-age production. The fall of 1954 was extremely dry and none of the grains grew much before January.

In 1958 oats did not produce enough forage to clip from December 1 to March 1. Rye produced forage during this time, making nearly twice as much total forage as oats to March 1 (4715 lbs. for Gator rye to 2404 for Arlington oats). In 4 years out of 9, oats produced as much or more forage than rye. These were fairly mild winters favorable to growth of oats.

11:10 A.M. Variations in Performance of Guineagrass (Panicum maximum) as Influenced by Environmental Factors - J. Velez Fortuno, Puerto Rico

This report deals with observations on the influence of seasonal fluctuations on the yield of green forage and composition - protein content and yield, and dry matter content and yield - on Guineagrass, Panicum maximum L., in Puerto Rico.

Weather data - precipitation, temperature and light hours, are presented for Isabela, year 1957; Gurabo and Castaner, part of years 1956 and 1957, which are the locations in which these experiments were conducted. The data obtained indicate that the forage yield, dry matter content, dry matter yield, and protein yield vary during the year, all following a similar pattern and more or less directly with weather factors, precipitation, temperature and daylight hours. The period of December to March is characterized normally and in general by low precipitation, cool temperature, and shorter days. During this period the forage yield, dry matter content, dry matter yield, and protein yield are low. After March these start to rise, reaching their highest level during the period of June to August, when they start to decline again. Protein content varies in the opposite direction, being high during the period of December to March; and when the other characters increase, it declines, being at its lowest during the period of June to August.

These observations are useful in the evaluation of grasses to suit our conditions and also in determining the proper method for the most efficient utilization as pasture or soilage grasses.

11:25 A.M. Problems in Breeding Red Clover and Dallisgrass Linked with Environment - C. R. Owen, La.

Effects of environmental fluctuations in plant populations are recognized and experimental designs have been developed for their estimation. With certain forage crops such variables may seem more numerous and sometimes appear unusual to the extent of being unique. Problems with red clover and dallisgrass breeding are given as examples.

South Louisiana is considered out of the range of adaptation for red clover. Within the Mississippi and Red River bottom areas ecotypes of this species occur which have persisted for scores of years and are assumed to be acclimated. Ordinarily they act as annuals and depend upon reseeding.

Epidemics of powdery mildew are present among these lines in most seasons; however, there is sufficient variation among plants subject to powdery mildew infection to simplify the task of developing acclimated strains through the use of the resistant clones. Due to the presence of the root rot complex in the soil during most years, a majority of the clones fail to survive. It has been necessary to initiate other techniques for developing powdery mildew resistance in red clover adapted to the Gulf Coast.

Dallisgrass breeding in Louisiana has been conducted as a survey of the species for variation among native clones for fertility. Among plants in natural stands much of the expression for variation in seed setting was masked by the occurrence of heavy epidemics of ergot. Attempts at growing plants under screen cages in the field as protection from ergot were not successful. Experiments were conducted in the greenhouse during the winter and spring using flourescent lights. Seed heads harvested in March which had been formed during the winter months were free of ergot, but the number of seed formed from 100 florets was 9.1, for an average for 11 lines. The range between lines was 2.3 to 16.7 per 100 florets. Seed heads harvested April 15 which had matured after March 1 developed caryopses in from 14.9% of the florets as an average, and the range was from 2.3 to 26.0%. Heads harvested July 1 were less fertile than either March 1 or April 15 harvests. There were indications of line differences at each of the harvests. Environmental fluctuations inside the greenhouse apparently affected seed development in all lines included.

11:35 A.M. A Method for Obtaining Virus-free White Clover Clones - L. W. Baxter, S. Car.

The technique for obtaining white clover clones free of yellow bean mosaic consisted of growing clones at 50°F and then taking tip cuttings. These cuttings were placed in sterile, high humidity containers and allowed to root under a uniform temperature of 50°F. When rooted, the plants were grown in the greenhouse at 80°F to screen for the virus. Fifty-seven percent of the new clones were virus-free, using the described technique.

11:45 A.M. Adjourned for lunch.

Thursday - June 5 - Afternoon Session

1:00 P.M. Panel Discussion - Grass Plus Nitrogen vs. Grass Plus Legume for Forage - W. W. Woodhouse, S. Car. Panel Leader

E. C. Holt, Texas - Most adapted legumes, except alfalfa, act as winter annuals in Texas. Most studies indicate that the better legumes grown in association with warm season grasses extend the grazing season or result in a longer season of production. Total forage production with a legume is about the same as with 40 to 80 pounds of supplemental nitrogen but with a different distribution of production. With grasses

with a high yield potential, such as Coastal bermudagrass, less production is obtained with a legume than with optimum nitrogen fertilization.

Because of a hot, dry summer, spring management of a grass-legume mixture must be such that the legume will not retard the development of the grass. If excessive legume growth occurs, less grass production results later in the season.

Forage quality information is not available.

G. B. Killinger, Florida - The problem of grass plus nitrogen as compared to grass plus legume is rather simple, however, grass plus legume plus nitrogen does complicate the picture and is open to debate among many southern agronomists.

First, grass plus nitrogen is necessary and advisable only when compatible winter and/or summer legumes will not thrive. This is primarily true on mineral soils as opposed to organic soils. Several factors stand out when one deals with the economic aspect of nitrogen fertilization for grass pastures.

(1) Inherent ability of a specific grass to utilize nitrogen by producing a quantity of quality forage--this may vary from 30 pounds to over 500 pounds per acre annually.

(2) Soil potential--assuming liming, P, K, and minor element problems have been adequately met.

(3) Water--irrigation availability or advisability.

(4) Management--grazing intensity and timing.

(5) Timing of nitrogen applications and quantities--this is of major importance and often is responsible for economic success or failure. Secondly, grass plus one or more compatible legumes, winter or summer, is a natural and is responsible for many of the most successful pasture operations in the South.

(1) Grass-legume pastures furnish forage higher in essential minerals, vitamins and growth hormones than most grass pastures.

(2) Management of grass-legume pastures to maintain a continuous supply of nutritious feed is easier than for grass pastures.

(3) A longer grazing season results from grass-winter legume pastures.

(4) A favorable effect on fertility of cattle has been noted on grass-clover as compared to certain grasses.

(5) Economic returns are high--assuming soil, fertility, moisture and management are adequate.

Thirdly, grass-legume pastures plus nitrogen are advantageous under certain conditions where high production of quality forage is a necessity.

(1) Rate and timing of nitrogen to a grass-legume pasture can maintain or destroy the grass-legume balance.

(2) Management and grazing intensity is critical where quantities of nitrogen are added to such pastures.

(3) Irrigation or water supply is essential for highest economic returns under this system.

Finally the value of pastures, whether they be grass or grass-legume, are ultimately measured in terms of livestock or their products and these results are largely dependent upon the quality of such livestock or their potential.

G. W. Burton, Georgia - At the Georgia Coastal Plain Experiment Station we have obtained the equivalent of 50 to 100 pounds of nitrogen in added production from grass-legume mixtures when the legumes grew well. In 3 out of 6 years, good crimson clover grew on Coastal bermudagrass sod and gave about as much increased steer gain as 75 pounds of nitrogen per acre. In one year, it failed completely and in two years gave only fair production. On many sandy soils, legumes now available are not dependable enough to warrant their use. Farmers who have tried such legumes as Dixie crimson clover on such soils have shifted back to grass and nitrogen due to the failures they have experienced with the legumes.

C. Y. Ward, Virginia - Whether the nitrogen needs of grasses can most adequately and economically be met by use of legumes or mineral nitrogen fertilizers will depend upon:

1. Adaptation of legume species.
2. Response of the grass species to mineral nitrogen.
3. Quality of forage obtained by the two methods as shown by animal performance.

In the Mid-Atlantic and Northeastern United States, adaptation and continued production of legumes like alfalfa, ladino clover, red clover, and birdsfoot trefoil appear superior to the Southeast. Therefore, a realistic place for perennial legumes is much more tenable in the northern perimeter of the southern region than further south.

The adaptation of legume species to the cooler parts of the southern region is only one factor in favor of their use as nitrogen suppliers. The northern grass species, after the first cutting, tend to be higher in quality than the southern grasses because they are entirely leafy. Southern grass species continually become stemmy due to repeated exsertion of seed stalks. Since the quality of the northern species is higher by nature, then the improvement of quality through the use of nitrogen fertilizer is less probable and more difficult than with the southern species.

While legumes may not afford a grass the maximum amount of nitrogen needed for peak production, the quality of the forage from the grass-legume mixture may more than offset the difference. A 6-year grazing study at the Northern Virginia Pasture Research Station shows higher daily gains and potential cattle grades for grass-legume mixtures as compared to the same grasses grown alone and fertilized with 216 pounds of nitrogen yearly. The livestock gains did not pay for the cost of the nitrogen. Another study in its third year has given data showing alfalfa with orchardgrass or fescue (no nitrogen) to be more productive than either of the grass species alone fertilized with as much as 300 pounds of actual nitrogen per acre.

In Virginia, with perennial sods, nitrogen fertilizer is an invaluable tool to be used as an emergency measure to provide earlier spring growth and late fall and summer grazing in periods of stress. In areas where legumes have failed or are difficult to establish, nitrogen fertilizer is useful.

2:20 P.M. Groups 1 and 2 - M. S. Offutt, Arkansas, Chairman
H. A. Fribourg, Tennessee, Section Secretary

Panel Discussion: Inbreeding in Sericea Lespedeza and its Relation to Environmant, Management, Irrigation, and Breeding Methods - P. R. Henson, Maryland, Panel Leader
W. A. Cope, North Carolina
E. D. Donnelly, Alabama
R. E. Burns, Georgia

P. R. Henson - Sericea lespedeza is considered to be a self-pollinating crop. The early work on the herbaceous lespedeza species revealed the presence of cleistogamous and chasmogamous flowers. Early attempts to hybridize lespedeza failed, resulting in the general belief that the species were entirely self-pollinated. The studies of Hanson(1943) on Korean lespedeza and of Hanson and Cope(1953) on serices showed the cleistogamous flowers to be self-pollinated and the chasmogamous to be normal and open-pollinated. The late R. E. Stitt, located at Statesville, N. C., first reported in 1946 that the chasmogamous flowers were largely cross-pollinated. Later Hanson and Cope (1955) reported evidence of heterosis in plants from chasmogamous flowers as compared to plants from cleistogamous seed.

Unhulled seed of sericea lespedeza can be separated into seed from cleistogamous and chasmogamous flowers(Slides 1 and 2). In general, the style or tissue on mature pods from cleistogamous flowers remains hooked while the same tissue on seed from chasmogamous flowers usually extends straight out from the end of the pod. The recent study showing essentially hybrid vigor in chasmogamous seed populations is responsible for considerable revision in the breeding methods with this species. There is considerable evidence that in the production of sericea seed in the future more attention must be paid to producing seed in an environment where maximum cross-pollination can occur.

W. A. Cope - Cutting treatments were imposed on cultivated spaced plants of sericea at Raleigh, N. C., and Beltsville, Md., in order to measure the effect of such management practices on percent of cleistogamous seed. Treatments consisted of 0, 1, 2, and 3 hay cuts before letting go to seed. The first hay cut at each location was in May, and the last was the first part of August. Two strains, Beltsville 22-68 and 22-75, were used at each location. Plants were in the second year of growth or older.

Results: (1) There was a progressive increase in percent seed from cleistogamous flowers with number of cuttings after the first, there being little difference between not cutting and cutting once. At Beltsville, strain 22-68 varied from approximately 50% cleistogamous seed for one cut to 85% for 3 cuts. Corresponding values for strain 22-75 were 60% and 95%. There was a definite strain-location interaction; at Raleigh the corresponding values were 40 and 95% for strain 22-68 and 5 and 90% for strain 22-75.

(2) At Raleigh, measurements were made on percent of early flowers setting seed and on the date of appearance of first pods from cleistogamous flowers. The first flowers set relatively few seed in each strain, only about 10% for strain 22-68 and about 25% for strain 22-75.

The first cleistogamous flowers appeared about September 29 in strain 22-68, regardless of treatment. In strain 22-75, cleistogamous flowers appeared somewhat earlier and there appeared to be a tendency toward delay of cleistogamous flowers with the more severe cutting treatments. From general observations, however, it appears that relatively few cleistogamous flowers are produced until late in the flowering period.

Conclusions: With spaced sericea plants under cultivation, cutting one crop of hay did not increase the percent of cleistogamous flowers over not taking a hay cut. More severe cutting treatments sharply increased the percent of cleistogamous flowers.

Factors causing the formation of cleistogamous flowers in sericea appear to be predominantly seasonal, with normal flowers appearing much earlier than cleistogamous ones. Therefore, management practices which leave the plant at a relatively immature stage at the time of initiation of cleistogamous flowers may be expected to result in a high percent of cleistogamous seed.

E. D. Donnelly - A preliminary experiment to determine the effect of irrigation and clipping management on the proportion of cleistogamous and chasmogamous seed of sericea lespedeza was conducted at Auburn, Ala., during 1957.

The variables studied were as follows: sprinkler irrigation on the basis of soil inspection versus natural rainfall; clipping once when average height of plants was 20 inches(June 23) versus no clipping: on 18 lines of sericea.

Approximately 6 inches of irrigation water was applied during July, August, and September. Rainfall plus irrigation water totaled approximately 8, 5, and 7 inches for July, August, and September, respectively. It is believed that more irrigation water should have been applied during August for a more exact evalution of the effect of moisture on percentage of chasmogamous seed.

All 18 lines in the experiment had been selected for fine stems, vigor, persistence, and other desirable agronomic characteristics. No differences among lines in forage yield were indicated when clipped.

Lines varied significantly for seed yield and proportion of chasmogamous seed. The 18 lines exhibited a range in seed yield from 13 grams to 495 grams per 9-foot^2 plot, and a range in percentage chasmogamous seed from 18 to 67%, depending upon clipping and irrigation treatment. One line was lowest in percentage of chasmogamous seed regardless of clipping or irrigation treatment, and another line was highest regardless of these, even though the interaction, lines x clipping, was significant both for percentage chasmogamous seed and seed yield. The 18 lines reacted alike as far as irrigation was concerned.

Clipping once during the growing season reduced the yield of seed (table 1) and the proportion of chasmogamous seed (table 2).

Table 1. Yield of Sericea Lespedeza Seed in Grams Per Plot when Irrigated and Clipped Differentially. Average of 18 Lines

Treatment	Clipped	Not Clipped	Mean
	Gm.	Gm.	Gm.
Irrigated	66	266	166
Not irrigated	37	211	124
Mean	52	239	145

Table 2. Percent Chasmogamous Seed of Sericea Lespedeza when Irrigated and Clipped Differentially. Average of 18 Lines

Treatment	Clipped	Not Clipped	Mean
	%	%	%
Irrigated	26	50	38
Not irrigated	34	47	41
Mean	30	49	39

Irrigation had no significant effect on yield or type of seed.

R. E. Burns - A survey was made of seed lots from various locations in the Southeast to determine the percent cleistogamous seed present and the comparative weights of the two seed.

The latitude (and thus day length and growing season) at which the seed were grown appeared to have little effect on inbreeding. Other factors were more important.

Hay and grazing practices had somewhat more effect. This was reduced to some extent by the fact that hay was often made early and grazing was either early in the summer or not heavy enough to prevent seed formation. Of the fourth of the seed lots which had the highest number of cleistogamous seed, 57% of the fields had beem mowed or grazed. In the other fractions, 25 and 43% had been so managed.

In samples in which an excessive number of seed were hulled the proportion of cleistogamous seed in the unhulled seed were consistently low. This was also true of the seed from the mountains and foothills.

The weight per 100 cleistogamous seed was 92% of the weight of the chasmogamous seed. This indicates the heterozygous nature of commercial seed lots.

It appears that in a seed production program, management practices would be more important than location in producing seed with maximum or minimum crossing(Seed lots used in this study supplied by SCS technicians).

3:05 P.M. Panel Discussion: The Use of Animals to Evaluate the Palatability of Breeding Lines in Forage Crops Improvement - H. W. Bennett, Miss., Panel Leader
N. L. Taylor, Ky.
M. E. McCullough, Ga.
G. W. Burton, Ga.

H. W. Bennett - The word "palatable" is defined as agreeable to the taste, savory, and hence acceptable and pleasing; however, the term "palatability" indicates the readiness with which herbage plants are selected and eaten.

Animals: (a) Usually the closer the relationships between groups of animals, the more they resemble one another in food preference, as sheep, cattle, goats, swine.

(b) Food preference is influenced by age and condition of animal, as:

suckling animals = succulent or tender plants or parts of plants
hungry animals = all plants and parts of plants - as hunger is appeased they become more fastidious
animals suckling young are less selective than fat ones
lean animals least selective

(c) Differences in palatability between one plant and another, or between the different parts of a plant are more marked in a well-fed animal than the lean or hungry animal.

Plant: Species of plants vary in physical characters and in chemical composition, therefore vary in palatability.

(a) high ratio of leaf to stem consumed to greater extent than stemmy and more fibrous parts.

(b) stage of growth = young, actively-growing herbage perferred
(c) weather: dry weather, leafy herbage; wet weather, stemmy herbage
(d) soil: fertilizers or fertile soil = better species and higher nutrient content

Methods of measuring: (a) animals have access to one type of food
(b) " " " " more than one type

Mississippi: Sorgo x Johnsongrass segregates F_2, F_3, F_4, F_6. Cattle consistently grazed plants with juice and carbohydrates regardless of size.

Johnsongrass selections - no selective grazing provided comparable stage of growth.

N. L. Taylor - One of the methods being used for the improvement of tall fescue for palatability at the Kentucky Station consists of inbreeding selectively grazed spaced plants for a number of generations, followed by crossing selected lines in polycross blocks. The polycross progenies and synthetics are then further evaluated in replicated sod plots by the use of grazing animals. After two generations of selection using this method of improvement, a replicated sod plot test was established in 1956 to evaluate the progress of the program. The test consisted of the syn. 1 and syn. 2 of 8 inbred lines, the polycross progenies of 4 lines, a relatively vigorous inbred line designated as 45-50, and the progenies of certain inbred lines outcrossed to Ky. 31 fescue, and G1-43 fescue. Ky. 31 fescue and 3 naturalized strains were used as checks. The test was grazed 4 times during 1957. Most closely grazed plots were given a rating of 1 and ungrazed plots 9, while plots with intermediate grazings were assigned ratings of 3, 5, and 7. The range in average degree of grazing for all 4 grazings was from 1.00 for inbred line 45-50, to 7.00 for one of the naturalized strains. Differences in degree of grazing between entries was highly significant. The synthetics and polycross progenies of all inbred lines except one were significantly better grazed than Ky. 31.

A new cycle of selection was initiated in 1954 by selecting within the spaced plant progenies of a synthetic of 8 inbred lines and 4 inbred lines outcrossed to Ky. 31. A nursery consisting of 25 selected lines from each family was grazed 5 times in 1957. Plants of Ky. 31 were used as a check in each family. After each grazing, plants were rated from 1 for the most closely grazed to 7 for ungrazed plants. Differences

in degree of grazing between lines within each family were highly significant. The average degree of grazing for families varied from 3.56 to 3.82, while the average rating for Ky. 31 was 4.37. Only 6 lines out of 125 in the test were rated as more poorly grazed than Ky. 31.

A second breeding procedure in the improvement of tall fescue for palatability consists of hybridizing tall fescue with annual and perennial ryegrass. The F_1 hybrids are male-sterile and largely female-sterile; however, a small amount of seed is obtained when the plants are backcrossed to fescue or ryegrass. Plants of 159 lines originating from F_1 hybrids, some of which were backcrossed one, two and 3 generations to tall fescue, were established in replicated spaced plant nurseries for grazing trials. Plants of Ky. 31 were used for comparison. The nursery was grazed 5 times in 1957. The average degree of grazing varied from 2.89 to 5.10 for the hybrid backcrosses. Plants of Ky. 31 had an average rating of 3.92. One partially fertile backcross line was extremely well grazed and a second generation backcross parent had 25 lines consistently better grazed than Ky. 31. Using the average rating of Ky. 31 as a basis for comparison, 109 lines were more poorly grazed than Ky. 31. Some poorly grazed lines contained plants well grazed.

An effort is being made to obtain fertile hybrids by treating the F_1 plants with colchicine. Five plants obtained from F_1 hybrids treated with colchicine were examined for viable pollen in the greenhouse during 1957. One exceptionally leafy plant produced large quantities of viable pollen and a second plant produced limited amounts of pollen from a few anthers. The remaining 3 had limited amounts of viable pollen in anthers that did not dehisce.

G. W. Burton - Significant differences in palatability have been obtained between varieties of bermudagrass at the Georgia Coastal Plain Experiment Station. Quantitative measurements of palatability where animals had free choice of 5 bahiagrass selections and hybrids showed broadleafed types were preferred to Pensacola bahia. Often more than twice as much of the broadleafed types were grazed. When cattle were confined to pure stands of these grasses, however, the broadleafed types were no better. In an earlier test, Pensacola bahia yielded 8,707 pounds of green matter per acre and 207.7 pounds of gain; whereas Paraguay bahia yielded 7,250 pounds of green matter and 105.1 pounds of gain per acre. The Paraguay strain in this test was very unpalatable and apparently affected adversely the animal preformance.

3:45 P.M. Heterosis in Sudangrass x Grain Sorghum F_1 Hybrids and the Status of Hybrid Sudangrass - J. P. Craigmiles, Ga.

Considerable interest has been shown in the value of forage sorghum, grain sorghum, sorgo, and sudangrass for forage and silage. Although all of these species cross readily with each other, little or no information is available on the yield and desirability of the F_1 hybrid between combine grain sorghum and sudangrass. This is a report of the forage yield of such a cross.

Crosses were made between male-sterile combine Kafir-60 x Tift sudangrass and male sterile combine Kafir-60 x Rhodesian sudangrass (Sorghum arundinaceum, P.I. 156549) in 1956. F_1 hybrid seed from these crosses were planted in a randomized block design at 3 locations in Georgia and forage yield determined for the hybrids, their sudangrass parents, and 4 hybrid forage sorghums (NK3055, NK3065, Dekalb 1-49-93, and S-210). Three clippings were made and in addition to the dry matter determinations, the leaf-stem ratio was computed as a measurement of quality.

As tabulated below, the F_1 hybrids averaged 29.1% more dry forage than the average of the sudan parents and forage sorghums.

Comparison of the forage production of sorghums, sudangrass and the F_1 hybrid, sorghum x sudangrass. Average of 3 locations.

Species	Lbs. dry matter per acre
Tift sudangrass	8185
Rhodesian sudangrass	8414
Forage sorghum	8340
Tift x sorghum (F_1)	10903
Rhodesian x sorghum (F_1)	10565
L.S.D. (5%)	

The F_1 hybrid is similar to sudangrass although it has broader leaves and thicker stems. It possesses an open panicle-type head with seed of the same shape, size, and appearance as the grain sorghum parent. The hybrid had 11% fewer leaves than the sudangrass parent, which suggests a lower quality forage.

The Status of Hybrid Sudangrass - No report has been found where the cytoplasmic male-sterility used in developing hybrid grain sorghum has been successfully transferred to commercial varieties of sudangrass. The transfer has been unsuccessful at this Station because of the presence of fertility restoring factors in the varieties of sudangrass used. Rhodesian sudangrass (S. arundinaceum, P.I. 156549), commonly referred to as wild sudangrass, is a vigorous, leafy plant with considerable leaf spot disease resistance and has shown promise in the variety tests in Georgia. The unique characteristics of this foreign introduction is that it does not possess genes for restoring fertility when crossed to the cytoplasmic male sterile Kafirs. The lack of these restorers (or presence of inhibitors) provides a means of obtaining a male sterile sudangrass.

By a series of backcrosses the cytoplasmic male-sterility has been successfully transferred to Rhodesian sudangrass which is presently in the fifth backcross generation. F_1 hybrids between male sterile Rhodesian x Tift and male sterile Rhodesian x Piper appear outstanding in leafiness and forage production.

Discussion:

Question: Is hybrid vigor a factor in your forage sorghums?

Bennett(Miss.): We get a 50% increase in hybrid vigor with segregation in F_2. Plants of different types were selected so as to maintain around a 30% increase in vigor in selections.

Burton(Ga.): Seed of the Ga-Hi variety are produced by mixing seed of 4 inbred lines which produce a 75% hybrid seed stock. Each of the 4 inbred lines carry genetic markers which permit the identification of inbred plants in the hybrid population. In field seedings only the vigorous hybrid seedlings persist. We have been able to maintain the 4 inbred lines satisfactorily.

McLain(S. Car.) briefly reviewed his program, pointing out that he was just getting started. He is interested in disease resistance and quality as affected by sweetness, grain and leafiness. He is also studying male sterility.

4:05 P.M. The Use of Bee Cages to Control Pollination for Production of Seed for Evaluating Breeding Lines - N. L. Taylor, Ky.

In any plant breeding program, seed quite frequently must be produced in isolation for reasons of recurrent selection, crossing, or increase of seed for testing. Isolation may be achieved for legumes by distance or by caging.

At the Kentucky Station, where a recurrent selection program is being conducted with red clover, caging has been used because of the relatively large number of different selections being increased.

The bee pollinating cages which have been in use since 1954 are 8 feet wide, 4 feet high, and 15 feet long. The frame consists of 3/4" galvanized steel pipe secured at the corners with cast aluminum fittings tightened with allen screws. Fitted over the frame is a 12 x 12-mesh lumite cover which is fastened at the corners by zippers. Metal rods inserted through metal grommets in the webbing of the screening and driven into the ground prevent the cage from being overturned by high winds.

Plants are transplanted into the area to be caged after the soil has been disinfected by the use of methyl bromide. If plants are spaced on 6-inch centers, the cage will accommodate about 420 plants, allowing a small area in one corner for the bee hive.

One 3-pound package of honey bees with queen is ordered each year for each set of cages desired to be pollinated. About May 1 in Kentucky seems to be the optimum date to schedule arrival of the bees. Earlier arrival requires excessive feeding with sugar syrup. The bees are usually hived in small 4-frame hives and placed in the apiary until it is desired to begin the pollinating.

With red clover, seed is produced on the second crop when blooming of plants is fairly uniform. The bee hive should be placed in the cage several days before blooms begin to appear in order to avoid contamination. Many of the older bees apparently cannot adjust to the cage and die; however, the younger bees do an effective job of pollinating. If the hive is strong enough it may be used a second time. After two cagings the hive is generally quite weak and no attempt is made to overwinter the hive.

The highest seed yields were obtained with Kenland red clover transplanted in June 1956, when 294 grams of cleaned seed were produced. Other less-adapted varieties produced considerably less. In 1955, when the date of transplanting was July, only 94 grams of Kenland were produced. In 1958, all plants were established in May. It is possible that yields could be increased by other changes in the technique. No seed has been produced on any crop except red clover; however, it is expected that some data will be obtained in the 1958 season on seed yields of white clover and birdsfoot trefoil.

4:25 P.M. Some Thoughts on Methods of Handling Apomictic Species - J. R. Harlan, Okla.

1. Since apomixis is an important evolutionary mechanism, it should also be an important breeding tool if we can find ways and means of exploiting it.

2. In working with apomicts it is essential to study carefully all of the nearest relatives in order to understand the cytogenetic composition of the group as a whole. This will lead to the study of plants with no agronomic potential at all. The plant breeder cannot reject material just because it is completely unadapted and agronomically useless.

3. Most apomictic complexes have sexual or facultative types or both. These are the keys to a breeding program. In the classic complex, the diploids are sexual, the tetraploids have some facultative types, and higher ploidy levels may be obligate apomicts. Sexual tetraploids may often be produced by doubling diploids.

4. Many apomicts have the potential for reproducing sexually by means of unreduced eggs. Crosses can thus be made but they involve a genome building mechanism.

5. Heterosis can occur in some hybrid combinations and this vigor can be fixed by apomixis. This is the great advantage of the phenomenon and should be exploited to the fullest in breeding programs.

6. Even obligate apomicts can be used in breeding programs as male parents with facultative types.

7. Wide crosses are often possible where the female parent is a facultative apomict producing occasional unreduced gametophytes with a sexual potential.

As a matter of fact, differences in ploidy level are less effective as barriers to gene exchange in apomicts than in sexual types.

8. There are many things about apomicts we do not understand, but so many important species reproduce by this method and the potential of the mode of reproduction in plant breeding is so great that a really major research program of apomicis is justified.

4:45 P.M. General Discussion.

Friday, June 6, 1958

Morning Session - Groups 1 and 3

W. B. Anthony, Alabama, Chairman
W. A. Hardison, Virginia, Section Secretary

8:00 A.M. **The "Put and Take" System of Handling Cattle for Evaluating Production on Grazing Paddocks** -

R. E. Blaser, Va., Panel Leader
W. R. Langford, Ala.
P. G. Woolfolk, Ky.
H. L. Lucas, N. Car.

R. E. Blaser: We also refer to this as the "tester" and "grazer" technique. We used this plan in grazing experiments conducted in Florida in 1938 and it is now used at the Northern Virginia Pasture Research Station and other grazing experiments in Virginia. It is necessary to vary the stocking rate per acre because growth varies in different seasons. Quality of pasture herbage is measured by the performance of grazers and pastures are stocked so that there will be adequate feed for the testers during the slowest herbage growth periods. Grazers are added or withdrawn, depending upon the availability of the feed. Carrying capacity data are obtained from the combined stocking of grazers and testers. Yield of beef per acre is obtained by using the quality data obtained from the testers and multiplying this by the total carrying capacity for the season.

This system of handling animals on grazing experiments has been used satisfactorily with steers, milk cows, and sheep.

W. R. Langford: In evaluating pastures it is desirable to determine both quality and quantity of the herbage available throughout the growing season. Both of these characteristics are influenced by a number of factors, each of which, when taken alone, may be difficult to evaluate, but the combined effect of all factors that influence quality and quantity of herbage can be measured in a grazing trial if pastures are stocked at their optimum carrying capacity. The performance of tester animals gives us a measure of herbage quality and how it fluctuates during the growing season. "Put and take" animals give us a quantitative measure of the herbage and changes that occur in the carrying capacity. Stocking too lightly results in low yields per acre but has little effect on daily gain per animal until herbage approaches maturity and declines in quality. Overstocking results in poor daily gains per animal, low yields per acre, and damage to the sward.

Results from the "put and take" system of handling animals are generally applicable to farm herds and pastures. Furthermore, this procedure or some modification of it should be used by farmers in managing pastures and herds to avoid overgrazing and starvation during periods of little growth, and to utilize forage and maintain quality during periods of rapid growth.

The "put and take" system of handling animals might be improved by adjusting the stocking rate on the basis of a quantitative measure of forage available rather than on visual observation of changes in herbage growth.

P. G. Woolfolk: No abstract.

H. L. Lucas: No abstract.

Discussion following presentation of "put and take" system of handling cattle:

Sell: "Put and take" system can be used to advantage in certain studies. In other studies set-stocking may be used more profitably.

King: How may the system be made more objective?

Langford: Shift cattle depending upon amount of forage available. The forage may be measured by clipping or by the use of cages.

Ward: I would prefer to observe pastures daily rather than clip or use cages.

Southall: Maximum gains per animal can be obtained by using put and take system, however, more beef per acre can be obtained by set-stocking.

Killinger: How does put and take system compare with harvesting extra forage for feeding at a later date?

Langford: Livestockmen need to follow a systemized cropping system for efficient utilization of forage. I think the 12-month feeding program proposed by the Virginia workers is good.

Hodges: Should consider grazing management (put and take or harvesting excess growth) from experimental technique angle. The one used will depend on the answer you're after.

Anthony: What data do you get from the put and take system of management?

Ward: (1) Quality of forage as measured by rate of gain of the "tester animals".

(2) Total carrying capacity of pasture obtained from both the "testers" and "grazers".

(3) Total pounds of beef per acre.

8:40 A.M. Relation of Chemical Composition of Forage Plants to Their Nutritive Value - W. A. King, South Carolina, Panel Leader
H. L. Lucas, North Carolina
W. E. Thomas, North Carolina
George Hawkins, Alabama

H. L. Lucas: The ultimate solution of forage evaluation problems requires the development of a quantitative conceptual framework in which the total picture may be viewed. At Raleigh, attempts have been made to develop several facets of this general framework. Preliminary results of one phase of this work will be reported here, namely, work on the relationships of the apparent digestibility of feeds to the chemical composition of feed and feces.

This work on digestibility has three aspects;

(1) A theoretical phase aimed toward deriving a meaningful mathematical form in which to express the relationships of digestibility to feed and fecal composition.

(2) An experimental phase aimed toward assessing the adequacy of the theory developed.

(3) An experimental phase aimed toward ascertaining improved methods of chemically characterizing feeds, using the developed theory as an aid.

In this work emphasis has been placed on the utilization of forages by ruminants.

Theoretical Work

A theory has been developed, based on the following assumptions:

(1) Feeds consist of two or more physical components.
(2) Each physical component has a unique and invariant chemical composition.
(3) Each physical component is unique and invariant with respect to apparent digestibility of the dry matter and of each chemical entity in the component.
(4) Variations between feedstuffs and between samples of the same feedstuff, with respect to chemical composition and apparent digestibility, are attributable to variations in the ratios of the physical components.

These assumptions provide certain basic mathematical identities. Algebraic manipulations yield explicitly the desired theoretical relationships between apparent digestibility and the chemical composition of feed and feces.

The assumptions taken together imply the following: If feeds contain n physical components, n-1 chemical entities must be measured in order to predict the "overall" apparent digestibility of a feed. Overall apparent digestibility may be expressed as the apparent digestibility of the dry matter. If so, the concentration of the predictors would be expressed as amounts per unit dry matter of the feed. One may, however, work with digestible organic matter or with gross energy. Concentrations of the predictors are then expressed as amounts per unit of organic matter or per unit of gross energy, respectively. To be useful at all, the predictors cannot be redundant (i.e., cannot be perfectly correlated), and, to be most effective, the predictors should be correlated to the minimum extent possible considering all forages.

Assumption 3 implies that the theory makes no allowance for "associative" effects in apparent digestibility nor for effects of level of feeding and physical state of the feed. Augmentation of the theory to encompass these complicating factors has been studied only to a limited extent.

In this paper attention will be focused only on the relationships of the digestible amounts (per unit of feed) of individual nutrients and of dry (or organic) matter to the composition of the feed. From the theory, these relationships all turn out to be of the general form

$$y = b_0 + b_1x_1 + b_2x_2 + \ldots + b_px_p \qquad (1)$$

where y is the apparently digestible amount of a certain nutrient or of the dry matter, the x's are the composition of the feed, and the b's are constants to be determined from experimental data. The b's take different values, of course, depending on the item represented by y.

Adequacy of the Theory

The relationships forthcoming from the theory have been fitted to a number of sets of published and unpublished data. So far, the theory seems to apply well when the ration consists solely of forages.

Chemical Characterization of Forages

Two questions may be asked. These are:

(1) How many chemical entities must be determined in the feed in order to adequately predict the "overall" digestibility of a forage and the apparent digestibility of important individual nutrients?

(2) What chemical entities should be determined in forages?

To answer these questions a program has been initiated which will involve digestion trials on a number of widely different forages, each harvested at many stages of maturity, and also will involve the determination of many chemical entities in feed and feces.

To date results of digestion trials with dehydrated alfalfa and dehydrated tall fescue (K-31) are available, but statistical analyses of results have not yet been carried to the final stage. This year weeping lovegrass and sericea lespedeza will be studied and additional trials on alfalfa and fescue will also be made.

Number of chemical entities to determine:

Each of several chemical entities has been found to predict the apparent digestibility of the organic matter in alfalfa quite well when used as the sole predictor. These entities (correlation coefficients in parentheses) are: crude fiber (-0.95), cellulose (-0.93), crude protein (0.90), chromogen (0.90), and lignin (-0.85). For the fescue samples, however, none of the chemical entities measured was satisfactory as a sole predictor. Thus, although the assumption of a 2-component system might serve adequately for alfalfa, assuming three or more components is necessary for forages in general.

Chemical entities to determine:

To be most useful, the formula to predict the apparently digestible amounts of dry matter (or organic matter or gross energy) and of individual nutrients in a feed from chemical composition should be the same for all feeds. This requires that a given chemical determination should measure the same chemical entity (i.e. the same chemical compound or group of nutritionally similar compounds) in all types of feed and should measure the same entity in both feed and feces. To be most effective the several chemical entities determined should be mutually exclusive; i.e. a given chemical should appear in only one entity. The several mutually exclusive/Chemical entities need not partition the feed or feces exhaustively; however, they must be sufficient in number to adequately predict digestibility.

Under the assumptions of the theory previously outlined, the premises related in the foregoing paragraph provide a clear-cut criterion for examining methods of chemically characterizing forages (or, in fact, feeds in general). This criterion is simply this: If proper chemical entities are being determined in the feed and these are used as predictors, i.e., as the x's in equation (1), then, upon fitting equation (1) to digestibility data from each of several species of forages, the b's should be essentially the same for all species of forage.

The preliminary statistical results obtained to date with alfalfa and fescue indicate the following: The entities represented by crude protein and ether extract are each good entities to determine. Crude fiber, nitrogen-free extract, and cellulose appear not to be good; this is not particularly surprising for crude fiber and nitrogen-free extract. An alternate method

of partitioning the fiber and other carbohydrate fractions has also been studied. It appears that determination of hot-water-soluble and 4%- and 72%-H_2SO_4-soluble carbohydrates offer a much improved partitioning. Results with lignin were inconclusive. Studies on chromogen (chlorophyll) were also inconclusive.

W. E. Thomas: In studying the relationships of chemical composition of forages to their nutritive value the nutritive evaluation is difficult to determine. A high total digestible nutrient intake is considered to be of particular importance in evaluating a feed for dairy cows. It requires about the same amount of TDN to maintain a 1000-lb. cow as it does to produce 25 pounds of milk. If the cow has the potential and obtains additional TDN, another 25 pounds of milk can be produced for just half the gross TDN required for the first.

In this discussion on nutritive value we should consider palatability to be of equal value to digestibility in evaluating forages. In some of our silage studies Sart has been superior to corn for the amount eaten but the cows ate less Sart and produced less total milk per cow per day. The factors used for estimating TDN yield in terms of weight change, maintenance and milk production should be opened for inspection. Some data at North Carolina State show the recovered energy as measured by calculated TDN to be too low.

G. E. Hawkins: This report is based on a study in which the nutritive qualities of 10 sericea hays were evaluated. The hays were first and second cuttings from each of 5 locations in Alabama. Each hay was fed to 3 dairy steers.

Simple correlations between chemical composition and hay consumption and between chemical composition and digestibility of hays were determined. The correlations between crude fiber, cellulose, nitrogen-free extract less tannin, O C (other carbohydrates, i.e., 100-crude protein, ether extract, ash, lignin and cellulose), O C less tannin, and O C less tannin plus lignin and hay consumption were significant. The first two correlations were positive and the others negative.

The lignin contents of the hays were negatively correlated with digestibility of dry matter and apparent digestibility of crude protein of the hays. Conversely, there was a significant positive correlation between digestibility of dry matter and the crude fiber contents of the hays.

Relationships between: crude protein, ether extract, lignin, tannin and ash and hay consumption; and crude protein, tannin and cellulose and digestibility of crude protein in the hays were non-significant.

Sericea is a rather unusual forage in that it is relatively low in several nutritive qualities at practically all stages of growth. Also, most of the relationships between the chemical composition and the measured nutritive qualities are unusual. Generally prediction equations based on crude fiber content of forages show that consumption and digestibility of the forages decreases as the crude fiber content increases. Nevertheless, the

sericea data indicate that increases in crude fiber content and decreases in soluble carbohydrates are associated with the sericea hays that are highest in nutritive quality.

The simple correlations resulting from this study suggest that sericea hay consumption is affected by some fraction of nitrogen-free extract other than tannin and lignin. It appears that the same fraction may affect rumen fermentation as the proportion of acetic acid found in rumen liquor from a steer fed sericea was 10 to 15% higher than that of cows fed alfalfa.

9:35 A.M. The Use of Indicator Techniques for Pasture and Forage Evaluation - W. A. Hardison, Virginia, Panel Leader
P. G. Woolfolk, Kentucky
M. E. McCullough, Georgia
Cecil Conley, South Carolina

W. A. Hardison - Exposure of acetone extracts of fresh feces to light resulted in an immediate increase in optical density, the increase being proportional to the light intensity. Extracts kept in the dark remained stable for about 5-6 hours after which a marked increase in optical density was observed. Most of the increase occurred within the first 50 hours following extraction. From this time to 200 hours after extraction, the rate of change in optical density was not appreciable. Extracts exposed to 14,000 F.C.M. immediately after extraction and then kept in the dark showed no increase in optical density even after 200 hours.

Data were presented to illustrate some of the problems which may be encountered in using chromic oxide as an indicator to estimate fecal outgo or dry matter digestibility in studies with ruminant animals.

P. G. Woolfolk - No abstract.

M. E. McCullough - No abstract.

Cecil Conley - No abstract.

Discussion:

Anthony: Can indicators be used to measure the relative value of pastures?

Hardison: Yes.

Sell: Indicator techniques have helped in our studies to point out situations where over-consumption of forages was encountered.

10:15 A.M. Animal and Plant Factors Related to the Seasonal Decline in Productivity from Summer Forages -

B. L. Southwell, Georgia, Panel Leader
R. L. Jeffers, Florida
O. C. Ruelke, Florida
E. M. Evans, Alabama

B. L. Southwell - In the lower Southeast, permanent grasses or permanent pasture mixtures do not give us the animal performance we need. During a summer grazing period of 200 days or more, we seldom get better than 1.25 pounds daily gain from yearling steers and usually not that much. As far as animal performance is concerned, apparently one grass is little better than another among the better grasses. From a moderate fertility basis, the increased use of fertilizers increases the liveweight gains per acre but increases individual animal performance very little. This is especially noticeable when daily gain is the measure and is almost as true when milk production is the measure.

Some of the reasons given to explain this are that the forages decline in quality as the season progresses or that the weather is too warm for good animal performance or that insects and diseases affecting both the plants and animals contribute to poor performance.

Steers placed on permanent pasture in the early spring make excellent gains for 60 to 80 days but there is a tendency for the rate of gain even in this period, to decline. There is a very definite decline in rate of gain beyond that period. Most permanent pastures produce about 75% of their cattle gains in the first half of the normal grazing period. We do not get good animal performance on our permanent pastures over a much longer period than we do on annual winter pastures.

Why can we not get as good animal performance from a 6-weeks growth of Coastal bermudagrass that took place in August and September as from the same amount of growth that took place on the same sod in April and May even when the same amount of fertilizer is applied to the sod just previous to the 6-weeks period during which the growth took place?

We are doing a better job yearly in cattle production in the Southeast. The area is destined to become a great cattle producing one. We have made great strides in our forage production program as we have in our animal breeding program. There are a lot of problems in our way. I have mentioned a few of them. The forage crops men and the livestock men working together, as we are, should be able to solve some of them.

R. L. Jeffers - No abstract.

O. C. Ruelke - Most of my thoughts regarding this subject will be directed toward the plant factors related to the seasonal decline in productivity of summer forages. As I see it, the factors most responsible include temperature, moisture, soil fertility, and management, although there may be many more important factors.

In Florida, temperature is the most important factor to consider when choosing a forage for the entire state. The rate of growth of pasture is closely related to temperature, however, during some periods there is a distinct decline in forage production when temperatures are favorable for growth. A study carried out by McCloud has shown that night temperature is related to this problem.

The most important factor to consider when choosing a pasture species for any specific area of Florida is moisture. In many cases it is the limiting factor in growing certain pasture species. In other cases it directly determines when fresh new forage will be available. In order for fertilizers to be effective we must have moisture to get the nutrients in solution. Work carried on by Killinger et. al. has shown that increasing the number of nitrogen fertilizer applications beyond two applications did not influence the seasonal distribution of forage as much as did the distribution and amount of rainfall.

Soil fertility is very important in most parts of Florida. Our soils are light and sandy and have a very low ion exchange capacity. Unless we use supplemental fertilization through the summer, the heavy summer rainfall leaches away the nutrients, leaving infertile soils and retarded forage growth. This is clearly demonstrated in time of application of nitrogen studies carried out by this writer.

The last point I would like to touch on briefly is management of pastures. All of us are familiar with the relationship between yield and quality of forage throughout the year. Despite the fact that all of us are familiar with the fact that quality declines as the grazing season progresses, I wonder how many of us do everything we can to keep the forage at its highest quality. In Florida cattle start out hungry in the early spring and by midsummer they are well fed. I also wonder what effect the intense heat of summer has on their desire to graze during the hot period of the day regardless of the quality of the forage.

There are many other factors that should be added, and these will depend more specifically on the area of the country which is considered.

E. M. Evans - We know that many factors, both animal and plant, influence the seasonal decline in productivity from summer forages.

The factors that influence animal performance are type, temperament, age, capacity, finish, acclimatization, and foraging ability. Whether or not the animal is hungry and protected from heat, flies, and diseases will also affect its performance.

The effect of animals on the grazed sward will also influence the way they perform. Contamination, spotty grazing, and selective grazing are often serious factors.

Some of the plant factors that influence animal performance are inherent in the cyclic nature of plant growth. It is normal for grasses to elongate rapidly and go through a period of deposition when relatively more carbohydrates are produced; then as maturity is approached the elaboration of certain differentiation products occurs. Some of these products

such as tannins tend to make forage unpalatable; some, such as lignins, tend to affect digestibility; others merely dilute the more desirable nutrient components.

From the plant standpoint, not all of these mechanisms are undesirable. Dormancy during periods of extreme stress permits retention of some reserves that are necessary for recovery when growing conditions again become favorable. Lignification of seed stem structures permits maturing and curing of seeds above ground in a favorable environment for maintaining viability.

If plants remained continually succulent, under many management systems animals would severely overgraze them. Sub-humid grassy plains would become very unproductive and desirable forage species in humid regions would be supplanted by weedy types. Probably the low regard for alfalfa as a grazing crop in some areas stems in part from the fact that it is grazed so readily and so completely that stands are short-lived.

Species and sward composition strongly affect animal performance during the latter part of the summer grazing season. The failure of yearling steers to fatten on summer perennial grasses has been well documented. It may be well to look at this situation from a slightly different angle. This type of animal is limited in capacity but has a high requirement, exceeded only by high-producing dairy cows. Forage must be rather high in quality to supply adequate nutrition for growth and finish. Perhaps we are expecting too much of a natural system when we try to fatten steers of this age on grass alone which is the natural diet of cattle. Actually, the only animals that require high degrees of fat storage are those warm blooded animals that live in the cold seas like the whale and animals that hibernate. One way to avoid the problem, and it is widely used, is to sell the calf with a milk fat finish. This system permits a higher stocking rate of cows that make better use of summer grasses.

Perhaps we will eventually develop stocker-feeder patterns in the Southeast similar to those of the plains and grain belt. The areas that must depend on summer grasses primarily could supply feeders to areas that grow an abundance of grain or where cool-season forages predominate.

Discussion:

Wells: Is hay cut in September as high in feeding value as the same hay cut in April or May?

Ward: British workers found that later cuttings of alfalfa were better than early cuttings.

King: Similar observations have been made in South Carolina.

Anthony: We have employed the use of high-energy mixed rations to good advantage in summer with beef cattle. Animals during midsummer under adverse environmental conditions gained well on such rations.

11:00 A.M. Business Meeting - P. B. Gibson, South Carolina, Chairman

The Nominating Committee proposed the names of Marshall McCullough as the new member of the Executive Committee and D. E. McCloud as permanent secretary. The motion was made that the nominations cease and the two were unanimously elected to the respective positions.

The Executive Committee for 1959 is made up as follows:

	Term expires
W. W. Huffine, Okla.	1959
P. B. Gibson, S. Car.	1960
E. C. Holt, Texas, Chairman	1961
N. L. Taylor, Ky.	1962
M. E. McCullough, Ga.	1963
R. H. Lush, Tenn., Dairy Husbandry	
D. E. McCloud, Md., Permanent Secretary	

The Resolutions Committee was asked for a report. Two resolutions were submitted as follows:

(1) The conference go on record as expressing thanks to the administration and staff of Clemson College for providing these excellent facilities and for arranging the well-conducted field tour.

(2) The conference express sincere appreciation to Mr. Paul Henson for his faithful service as permanent secretary of this organization during the past 10 years.

Both resolutions were passed unanimously by voice vote.

Chairman Gibson opened the meeting for a discussion as to where the conference is to meet next year. The Chairman further reported on a letter from Director Clay Lyle, inviting the group to Mississippi in 1959. The motion was made and seconded that the invitation from Mississippi be accepted. The motion passed unanimously.

Outgoing Chairman Gibson introduced the new chairman, Dr. E. C. Holt. There being no further business at hand, the meeting adjourned.

REGISTRATION LIST - 1958

Name	Address	Affiliation
Alabama		
Ansley, Bill	Auburn	Ala. Polytechnic Institute
Anthony, W. B	"	Ala. Agric. Expt. Station
Bennett, O. L.	Thorsby	Soil & Water Conservation
Cope, J. T.	Auburn	Dept. of Agron., Ala. Poly. Inst.
Donnelly, E. D.	"	Ala. Agric. Expt. Station
Evans, E. M.	"	" " " "
Johnson, W. C.	"	" " " "
Langford, W. R.	"	" " " "
Patterson, R. M.	"	" " " "
Arkansas		
Offutt, M. S.	Fayetteville	Dept. of Agron., Univ. of Ark.
Spooner, A. E.	"	" " " " " "
Delaware		
Rennie, W. W.	Wilmington	E. I. Dupont de Nemoirs Co.
Florida		
Allen, R. J. Jr.	Belle Glade	Everglades Expt. Station
Carver, W. A.	Gainesville	Fla. Agric. Expt. Station
Hodges, Elver M.	Ona	Range Cattle Station
Horner, E. S.	Gainesville	Fla. Agric. Expt. Station
Killinger, G. B.	"	" " " "
Linden, D. B.	"	" " " "
Peacock, H. A.	Leesburg	Watermelon & Grape Invest. Lab.
Prine, G. M.	Gainesville	Fla. Agric. Expt. Station
Ruelke, O. C.	"	" " " "
Rummell, R. S.	Fort Myers	S.E. Forest & Range Expt. Station
Strickler, P. B.	Alachua	Farmer
Wallace, R. W.	Quincy	North Fla. Expt. Station
Georgia		
Adams, W. E.	Athens	Dept. of Agron., Univ. of Ga.
Beaty, E. R.	"	" " " " " "
Bickers, Jack	Atlanta	Farm Journal, 1036 Peachtree St.
Burns, R. E.	Experiment	Ga. Agric. Expt. Station
Burton, G. W.	Tifton	Coastal Plain Expt. Station
Craigmiles, J. P.	Experiment	Ga. Agric. Expt. Station
Crawford, Y. W.	Athens	Soil Conservation Service
Daniels, Eston	Tifton	Coastal Plain Expt. Station
Dobson, J. W.	Blairsville	Ga. Mountain Expt. Station
Elkins, C. B.	Athens	University of Ga.
Forbes, Ian Jr.	Tifton	Coastal Plain Expt. Station

Name	Address	Affiliation
Georgia (cont.)		
Gantt, C. W.	Athens	University of Georgia
Hearn, C. J.	Tifton	Coastal Plain Expt. Station
Jackson, James	"	" " " "
James, Edwin	Experiment	Ga. Agric. Expt. Station
Luttrell, E. S.	"	" " " "
McCreery, R. A.	Athens	University of Ga.
McCullough, M. E.	Experiment	Ga. Agric. Expt. Station
Miller, W. J.	Athens	Dairy Dept., Univ. of Ga.
Morcock, J. C. Jr.	Atlanta	Allied Chemical Corp.
Newton, J.P.	Experiment	Ga. Agric. Expt. Station
Parker, E. M.	Atlanta	Spencer Chemical Corp.
Perkins, H. F.	Athens	Dept. of Agron., Univ. of Ga.
Reed, Fielding	Atlanta	American Potash Inst.
Rogers, Hayden	Athens	Dept. of Agron., Univ. of Ga.
Sell, O. E.	Experiment	Ga. Agric. Expt. Station
Sell, W. H.	Athens	Extension Service, Univ. of Ga.
Southwell, B. L.	Tifton	Coastal Plain Expt. Station
Tabor, Paul	Athens	Soil Conservation Service
Tweesky, Marvin	"	University of Ga.
Wells, H. D.	Tifton	Coastal Plain Expt. Station
Williams, G. G.	Athens	University of Ga.
Wofford, I. M.	Savannah	Southern Nitrogen Co.
Kentucky		
Stroube, W. H.	Lexington	Ky. Agric. Expt. Station
Taylor, N. L.	"	" " " "
Taylor, T. H.	"	" " " "
Louisiana		
Black, D. E.	Crowley	Rice Expt. Station
Ellzey, H. D.	Franklinton	La. Dairy & Livestock Expt. Station
Owen, C. R.	Baton Rouge	University Expt. Station
Maryland		
Alexander, C. W.	Beltsville	Plant Industry Station
Davis, R. E.	"	Animal Husbandry Div., ARS
Fulkerson, J. F.	"	Plant Industry Station
Hanson, A. A.	"	" " "
Hein, M. A.	"	" " "
Henson, P. R.	"	" " "
Hollowell, E. A.	"	" " "
McCloud, D. E.	"	" " "
Mississippi		
Bennett, H. W.	State College	Miss. Agric. Expt. Station
Johnson, C. M.	" "	" " " "
Knight, W. E.	" "	" " " "

Name	Address	Affiliation
North Carolina		
Blake, Carl	Raleigh	Agric. Extension Service
Carlson, Irving	"	N. C. Agric. Expt. Station
Cipolloni, Mary Ann	"	" " " "
Cope, W. A.	"	" " " "
Dobson, S. H.	"	" " " "
Hanson, C. H.	"	" " " "
Lucas, H. L.	"	" " " "
Matrone, Gennard	"	" " " "
Sherwood, Bob	"	" " " "
Smart, W. W. G. Jr.	"	" " " "
Thomas, W. E.	"	" " " "
Woodhouse, W. W. Jr.	"	" " " "
Oklahoma		
Bates, R. P.	Ardmore	Samuel Roberts Noble Foundation
Harlan, J. R.	Stillwater	Okla. Agric. Expt. Station
Huffine, W. W.	"	" " " "
Puerto Rico		
Velez-Fortuno, J.	Rio Piedras	Federal Agric. Expt. Station
South Carolina		
Baxter, L. W.	Clemson	S.C. Agric. Expt. Station
Beale, O. W.	"	" " " "
Beinhart, E. G.	"	" " " "
Boykin, W. B.	"	" " " "
Collings, G. H.	"	" " " "
Conley, Cecil	"	" " " "
Cooper, H. P.	"	" " " "
Eagles, L. D.	Florence	Soil Conservation Service
Earhart, R. W.	Clemson	S.C. Agric. Expt. Station
Epps, W. M.	"	" " " "
Eskew, E. B.	"	" " " "
Gibson, P. B.	"	" " " "
Godley, W. C.	"	" " " "
Jones, C. M.	"	" " " "
Jordan, J. A.	Columbia	Soil Conservation Service
King, W. A.	Celsmon	S. C. Agric. Expt. Station
Langdale, George	"	" " " "
Mason, W. A. Jr.	Newberry	Soil Conservation Service
Maurer, T. C.	Spartanburg	" "
McClain, E. F.	Clemson	S.C. Agric. Expt. Station
McNatt, F. L.	"	" " " "
Moore, K. F.	"	" " " "
Paden, W. R.	"	" " " "

Name	Address	Affiliation
South Carolina (cont.)		
Peele, T. C.	Clemson	S.C. Agric. Expt. Station
Smith, J. H.	"	" " " "
Stewart, E. H.	"	" " " "
Suman, R. F.	Blacksville	Edisto Expt. Station
Turner, E. C.	Clemson	Extension Conservationist
Woodle, H. A.	"	S.C. Agric. Expt. Station
Tennessee		
Fribourg, H. A	Knoxville	Tenn. Agric. Expt. Station
Lush, R. H.	"	" " " "
May, Larry	Nashville	Farm & Ranch Magazine
Texas		
Bashaw, E. C.	College Station	Texas Agric. Expt. Station
Holt, E. C.	" "	" " " "
Lewis, R. D.	" "	" " " "
Staten, R. D.	" "	" " " "
Virginia		
Blaser, R. E.	Blacksburg	Va. Agric. Expt. Station
Engel, R. W.	"	" " " "
Hardison, W. A.	"	" " " "
Miller, J. D.	"	" " " "
Shoulders, J. F.	"	" " " "
Taylor, L. H.	"	" " " "
Ward, C. Y	Blacksburg	Va. Agric. Expt. Station
Washington, D. C.		
Ronningen, T. S.	U. S. D. A.	Office of Expt. Stations